

PRELIMINARY DATA SUMMARY

August 1989

U.S. Army Engineer Waterways Experiment Station
Coastal Engineering Research Center
Field Research Facility
Duck, North Carolina

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CERC Field Research Facility Duck, North Carolina

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Measurements and Analysis work units at the U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's Field Research Facility (FRF) in Duck, North Carolina. The FRF staff collected and analyzed these data. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

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PART I: INTRODUCTION

The U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's (CERC's) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Figure 1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The research pier is a reinforced concrete structure supported on 0.9-m-diam steel piles spaced 12.2 m apart along the pier's length and 4.6 m apart across the width. The pier deck is 6.1 m wide and extends from behind the duneline to about the 6-m water depth contour at a height of 7.6 m above the National Geodetic Vertical Datum (NGVD). In addition, a main building contains offices, an instrument repair shop, and a data acquisition room.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local oceanographic and meteorological conditions. Bottom profiles along both sides of the pier and periodic bathymetric surveys are also performed.

This summary is intended to provide basic data as soon as possible after they are obtained. Questions and/or comments concerning the data may be directed to Mr. Michael W. Leffler at (919) 261-3511.

Part II presents the meteorological data; Parts III through VI present oceanographic data; Part VII presents nearshore profiles and bathymetry; and Part VIII, if included, documents special events that occurred at the FRF during the month.

Table 1 is a list of instruments used, their operational status during the month, and the data collection status. Figure 2 identifies the location of the instruments. The water depths at the wave gages and current meters vary and may be determined from information contained in Figure 7. Other installation information is contained in Table 1.

Times given in the report, unless otherwise specified, are referenced to eastern standard time (EST).

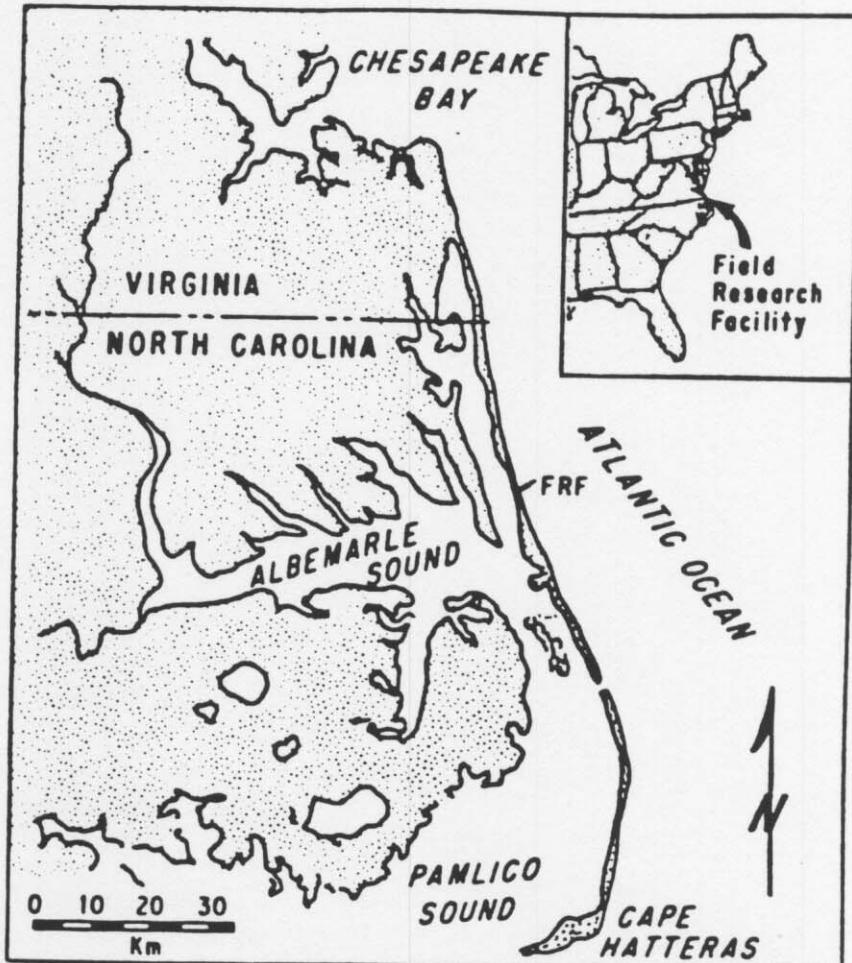


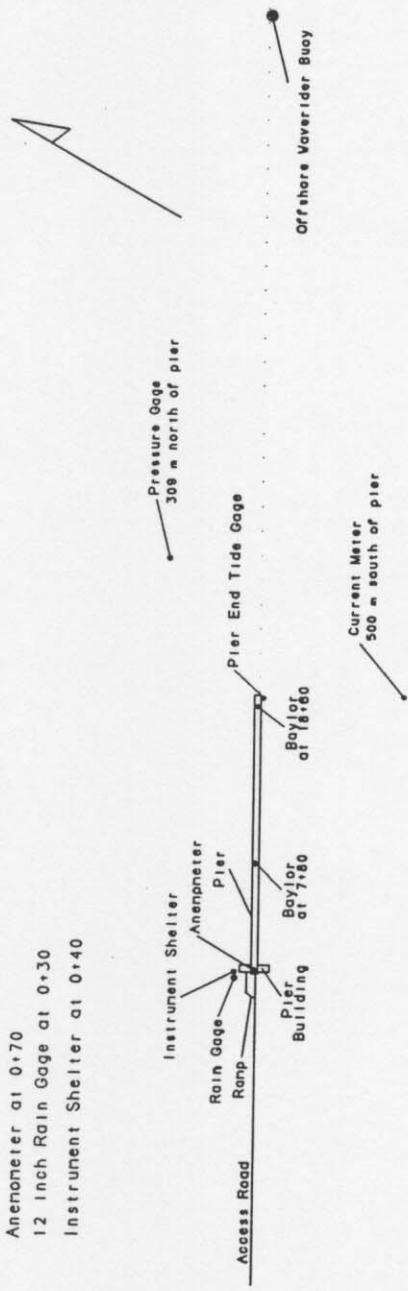
Figure 1. FRF location map

Table 1: Instrument Status/Data Availability

AUG 1989

Gage Status	Daily Observation	Analog Record	Data Collected
Operational = *	Complete = *	Complete = *	All = *
Partial = /	Partial = /	Partial = /	Partial = /
Non-Operational = -	None = -	None = -	None = -

Pier Building at 0+40 to 1+00
 Anenometer at 0+70
 12 Inch Rain Gage at 0+30
 Instrument Shelter at 0+40



CURRITUCK SOUND

ATLANTIC OCEAN

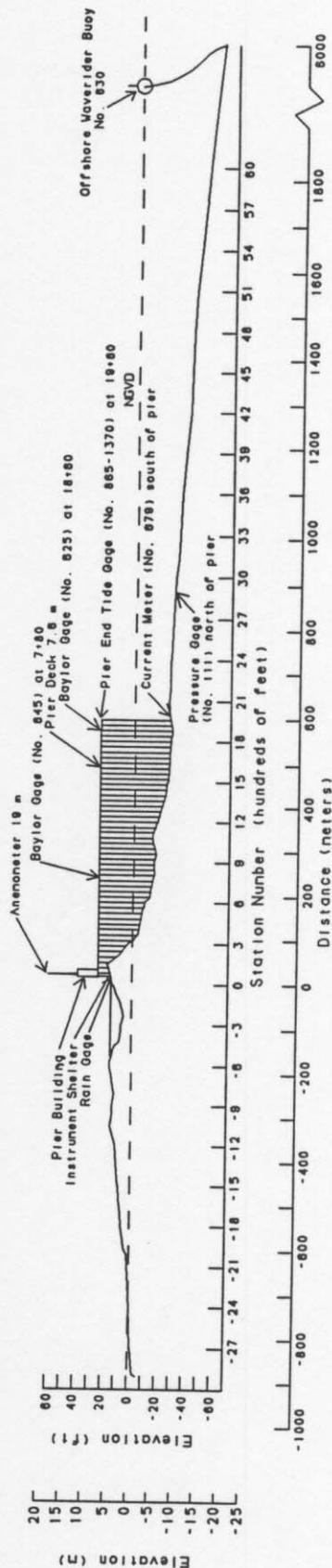


Figure 2. Instrument locations at FRF (all elevations from NGVD, all distances from FRF baseline).

PART II: METEOROLOGICAL DATA

A variety of instruments have been installed at the FRF (Figure 2) to monitor the meteorological conditions. The data presented in Table 2 are collected and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750. For each instrument identified in Table 1 as having analog outputs, chart records are obtained, a log is maintained and the records are stored for future reference.

Winds were measured at the end of the pier at an elevation of 19 m (Figure 2) using a Weather Measure Skyvane anemometer.

Monthly resultant wind speeds and directions are determined by vector averaging the data. Temperature and atmospheric pressure means are the average of the values presented for the month. Total precipitation is the sum for the month.

The following may be useful for converting the data in Table 2 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in.) -
 $mm \times .03937 = in.$
2. Millibars (mb) to inches of mercury (in. Hg) -
 $mb \times 0.02953 = in. Hg$
3. Degrees Celsius (C) to degrees Fahrenheit (F) -
 $(C \times 9/5) + 32 = F$
4. Meters per second (m/s) to knots (kn) -
 $m/s \times 1.943 = kn$

Table 2: Meteorological Data

Aug 1989

Day	Hour	*Wind Speed	*Wind Direction	Temperature	Atm Pressure	Precipitation
		m/sec	deg TN	deg C	mb	mm
1	100	6	50	24.5	1013.8	0
	700	7	55	22.6	1015.5	0
	1300	8	5	25.8	1015.9	0
	1900	5	47	24.0	1014.8	0
2	100	3	56	23.7	1015.2	0
	700	5	28	23.8	1014.8	0
	1300	4	13	25.2	1014.8	0
	1900	3	27	23.5	1013.1	0
3	100	2	265	21.9	1013.5	0
	700	5	290	23.8	1013.1	0
	1300	4	240	29.3	1012.5	0
	1900	5	261	27.6	1011.1	0
4	100	4	255	26.3	1010.8	0
	700	5	233	26.8	1010.4	0
	1300	5	232	30.7	1009.4	0
	1900	6	242	29.2	1007.0	0
5	100	6	232	27.5	1006.7	0
	700	6	241	26.8	1007.4	0
	1300	4	352	30.7	1006.4	0
	1900	5	146	27.7	1005.4	0
6	100	3	240	27.4	1004.7	0
	700	4	231	27.9	1004.7	0
	1300	5	140	31.0	1003.3	0
	1900	2	176	27.8	1003.0	0
7	100	2	139	26.3	1002.6	0
	700	1	228	27.9	1002.6	0
	1300	8	21	26.6	1001.3	0
	1900	4	331	24.0	1003.0	7
8	100	14	12	23.9	1005.7	0
	700	13	17	22.3	1009.8	0
	1300	8	360	19.7	1008.7	0
	1900	6	37	22.1	1013.8	0
9	100	5	63	22.6	1015.5	0
	700	8	64	22.7	1017.9	0
	1300	7	79	21.1	1018.9	0
	1900	11	30	22.3	1018.6	0
10	100	12	53	23.3	1017.2	0
	700	11	62	23.5	1016.9	0
	1300	9	80	24.8	1016.9	0
	1900	6	44	23.7	1015.9	0
11	100	1	76	23.8	1015.5	0
	700	4	9	23.0	1016.2	0
	1300	2	100	23.9	1015.9	11
	1900	2	164	23.9	1015.9	0
12	100	3	88	23.6	1015.5	0
	700	8	135	23.5	1015.9	3
	1300	8	141	23.9	1016.2	5
	1900	4	163	23.6	1015.5	0
13	100	3	124	23.5	1015.5	0
	700	0		24.4	1016.9	0
	1300	3	85	27.2	1016.5	0
	1900	3	167	25.2	1016.5	0
14	100	2	165	24.0	1016.5	0
	700	4	135	25.1	1016.9	0
	1300	4	66	27.3	1015.9	0
	1900	4	62	25.1	1014.8	0
15	100	4	80	25.1	1013.5	0
	700	5	79	25.5	1013.1	0
	1300	2	75	26.2	1012.5	0
	1900	4	48	24.9	1010.8	0
16	100	1	74	24.1	1010.8	0
	700	5	342	25.4	1011.1	0
	1300	3	33	27.6	1011.1	0
	1900	4	129	25.5	1010.8	0

(Continued)

Table 2: Meteorological Data

Aug 1989

Day	Hour	* Wind Speed m/sec	* Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
17	100	3	217	25.2	1011.8	0
	700	3	19	25.9	1013.1	0
	1300	4	99	29.6	1014.5	0
	1900	6	158	26.9	1014.5	0
18	100	7	122	25.9	1015.2	0
	700	6	83	25.2	1016.2	2
	1300	6	17	25.9	1015.9	0
	1900	4	226	24.6	1015.9	3
19	100	3	302	22.5	1017.2	0
	700	2	136	24.5	1017.5	0
	1300					0
	1900			Power Failure		0
20	100					0
	700	6	233	25.5	1018.6	0
	1300	4	223	28.7	1017.9	0
	1900	4	189	26.9	1016.2	0
21	100	8	220	26.2	1016.9	0
	700	7	223	25.7	1017.2	0
	1300	7	227	30.4	1016.2	0
	1900	7	207	28.3	1015.5	0
22	100	9	232	25.9	1014.5	0
	700	8	242	26.1	1015.5	0
	1300	6	83	28.6	1014.5	0
	1900	3	210	28.2	1013.5	0
23	100	8	229	26.5	1012.8	0
	700	8	247	26.5	1012.8	0
	1300	7	250	31.9	1010.8	0
	1900	5	243	29.5	1009.8	0
24	100	6	249	27.7	1009.8	0
	700	5	348	26.8	1010.8	0
	1300	8	23	27.0	1011.4	0
	1900	7	59	24.8	1011.4	0
25	100	6	51	24.3	1012.1	0
	700	8	64	24.4	1014.2	0
	1300	7	59	26.1	1014.8	0
	1900	6	48	24.4	1014.8	0
26	100	5	37	23.7	1014.5	0
	700	6	58	24.2	1015.5	0
	1300	5	56	26.1	1015.5	0
	1900	4	63	23.7	1014.5	0
27	100	4	106	23.7	1015.5	0
	700	3	106	25.0	1016.2	0
	1300	4	122	26.9	1017.2	0
	1900	5	104	24.5	1016.9	0
28	100	3	91	23.9	1017.9	0
	700	3	107	25.3	1018.2	0
	1300	4	122	28.5	1018.2	0
	1900	5	138	25.4	1017.2	0
29	100	3	193	24.5	1017.2	0
	700	4	220	26.0	1016.5	0
	1300	5	215	30.0	1015.5	0
	1900	9	186	26.9	1013.5	0
30	100	10	213	25.9	1012.8	0
	700	8	218	25.8	1011.1	0
	1300	7	273	31.3	1010.1	0
	1900	5	253	26.1	1009.4	3
31	100	2	285	25.6	1011.8	0
	700	7	7	24.6	1013.8	0
	1300	7	6	26.1	1015.5	0
	1900	5	58	23.9	1014.5	0
		Resultant		Mean	Mean	Total
		1	77	25.6	1013.3	34

* Anemometer at end of pier used (gage No. 932) (Sheet 2 of 2)

PART III: WAVE DATA

Wave data are collected from two Baylor staff gages (Gages 625 and 645), a pressure wave gage (Gage 111) and a Waverider buoy (Gage 630) as shown in Table 1 and Figure 2. The data are collected, analyzed, and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750 programmed to sample the wave gages every 6 hr (more frequently during storms) beginning at 0100, 0700, 1300, and 1900 EST. The sampling rate is two times per second for four contiguous 34-min records.

Wave height H_{mo} is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gage has been compensated for hydrodynamic attenuation using linear wave theory. Wave period is identified from the computation of a variance (energy) spectrum with 60 deg of freedom calculated from a 34-min record. Peak wave period T_p is defined as the period associated with the maximum energy in the spectrum. When this analysis is complete, the data are written to magnetic tape.

Table 3 presents the wave heights and periods for each wave record obtained at 6 hr intervals during the month. The monthly means and standard deviations from the means shown in Table 3 are average values computed from this data. Figure 3 is a time history of all H_{mo} and T_p values obtained for all gages.

Differences in wave periods between wave gages (Table 3 and Figure 3) may be the result of wave breaking, wave reformation, or the presence of multiple wave trains containing nearly equal energy.

Table 3: Wave Data

Aug 1989

Day	Hour	645		625		111		630	
		Baylor at 7+80	Hmo,m T,sec	Baylor at 18+60	Hmo,m T,sec	Pressure Gage	Hmo,m T,sec	Offshrd Wvrdr	Hmo,m T,sec
1	0100	0.39	2.98	0.56	8.00	0.47	6.24	0.62	7.31
	0700	0.81	5.82	0.76	4.27	0.79	3.51	0.83	8.53
	1300	0.74	4.83	0.82	4.34	0.82	5.95	0.80	5.69
	1900	0.68	5.82	0.77	7.76	0.79	8.83	0.86	7.53
2	0100	0.67	5.95	0.86	6.92	0.86	7.31	0.91	6.92
	0700	0.74	8.00	0.89	8.00	0.92	8.00	0.91	8.26
	1300	0.58	5.95	0.81	8.53	0.87	9.14	0.80	8.26
	1900	0.59	11.64	0.83	10.67	0.91	10.67	0.89	8.53
3	0100	0.56	6.74	0.80	9.85	0.83	8.53	0.77	9.85
	0700	0.42	9.48	0.66	7.11	0.72	8.53	0.69	9.14
	1300	0.28	9.48	0.58	8.00	0.55	8.00	0.55	8.53
	1900	0.24	9.14	0.44	9.14	0.44	9.14	0.53	9.14
4	0100	0.21	8.83	0.42	9.14	0.43	8.83	*	
	0700	0.25	9.48	0.41	8.53	0.45	8.83	0.45	8.26
	1300	0.22	8.53	0.35	8.53	0.38	9.14	0.43	8.53
	1900	0.26	11.13	0.44	9.14	0.44	10.67	0.55	9.14
5	0100	0.26	9.48	0.43	8.53	0.47	9.85	0.54	8.83
	0700	0.24	9.85	0.40	8.83	0.48	9.85	0.54	12.80
	1300	0.29	12.19	0.48	12.19	0.56	12.19	0.63	12.19
	1900	0.32	11.64	0.50	11.13	0.64	10.67	0.58	11.13
6	0100	0.33	12.19	0.55	11.13	0.62	11.13	0.63	10.67
	0700	0.31	10.24	0.56	10.24	0.60	10.24	0.69	10.24
	1300	0.34	11.13	0.58	11.13	0.61	9.48	0.75	11.13
	1900	0.39	11.64	0.68	12.80	0.72	12.19	0.77	12.19
7	0100	0.48	11.64	0.85	11.13	0.88	16.00	0.87	11.64
	0700	*	*	1.07	16.00	1.22	16.00	1.10	15.06
	1300	0.70	14.22	1.22	13.47	1.40	13.47	1.15	13.47
	1900	0.57	12.19	0.93	12.19	1.05	11.64	1.09	11.64
8	0100	1.36	5.69	1.64	5.45	1.94	5.33	1.90	5.95
	0700	1.39	6.74	1.82	6.40	1.97	6.09	2.12	6.40
	1300	1.06	6.74	1.19	6.40	1.29	9.48	*	
	1900	0.87	6.74	1.03	9.48	1.09	6.74	1.16	6.74
9	0100	0.72	6.24	0.91	8.83	0.94	8.83	0.97	8.83
	0700	0.77	5.69	0.98	8.53	0.92	8.53	0.98	8.53
	1300	0.71	4.34	0.95	4.57	0.94	4.41	1.05	4.66
	1900	0.96	4.57	1.22	4.49	1.24	4.49	1.31	4.74
10	0100	1.16	5.33	1.68	5.57	1.64	5.57	1.87	5.69
	0700	1.30	6.24	1.76	6.09	1.84	6.56	1.87	6.24
	1300	1.17	6.09	1.46	6.56	1.49	6.74	1.68	6.40
	1900	1.04	6.40	1.28	6.56	1.28	6.56	1.56	6.74
11	0100	0.86	6.40	1.04	6.24	1.21	6.09	1.19	6.40
	0700	0.66	6.40	0.83	6.24	0.85	6.56	0.90	6.40
	1300	0.61	6.09	0.85	5.95	0.90	5.95	1.01	5.82
	1900	0.52	6.09	0.77	6.74	0.81	6.92	0.92	6.40
12	0100	0.41	6.09	0.65	6.40	0.67	6.09	0.75	6.40
	0700	0.44	6.24	0.68	5.82	0.67	7.53	0.76	6.56
	1300	0.57	5.69	0.81	6.92	0.92	6.74	1.10	6.74
	1900	0.52	5.95	0.72	7.53	0.80	7.53	1.09	6.92
13	0100	0.43	6.24	0.67	6.74	0.70	6.40	0.90	6.09
	0700	0.44	6.40	0.64	6.56	0.68	7.11	0.84	6.74
	1300	0.40	6.56	0.55	8.00	0.65	6.09	0.77	6.56
	1900	0.37	7.11	0.51	7.53	0.55	6.74	0.66	6.92
14	0100	0.36	6.56	0.64	7.31	0.64	6.92	0.76	6.92
	0700	0.32	7.76	0.52	7.76	0.56	8.00	0.71	6.92
	1300	0.31	7.31	0.53	7.31	0.60	7.11	0.68	7.11
	1900	0.38	7.11	0.57	8.83	0.63	7.11	0.77	6.56
15	0100	0.46	7.11	0.62	8.83	0.69	8.00	0.81	7.11
	0700	0.48	6.40	0.73	7.31	0.70	7.31	0.90	6.74
	1300	0.50	7.11	0.73	7.31	0.80	8.00	0.84	6.56
	1900	0.46	6.92	0.70	7.31	0.75	7.31	0.83	7.53
16	0100	0.39	7.31	0.54	6.92	0.61	7.11	0.70	7.11
	0700	0.33	7.11	0.57	7.11	0.58	7.11	0.64	7.31
	1300	0.32	7.31	0.57	7.11	0.61	7.31	0.66	7.31
	1900	0.34	6.92	0.58	7.53	0.61	7.11	0.62	6.92

* Electronic problems

(Continued)

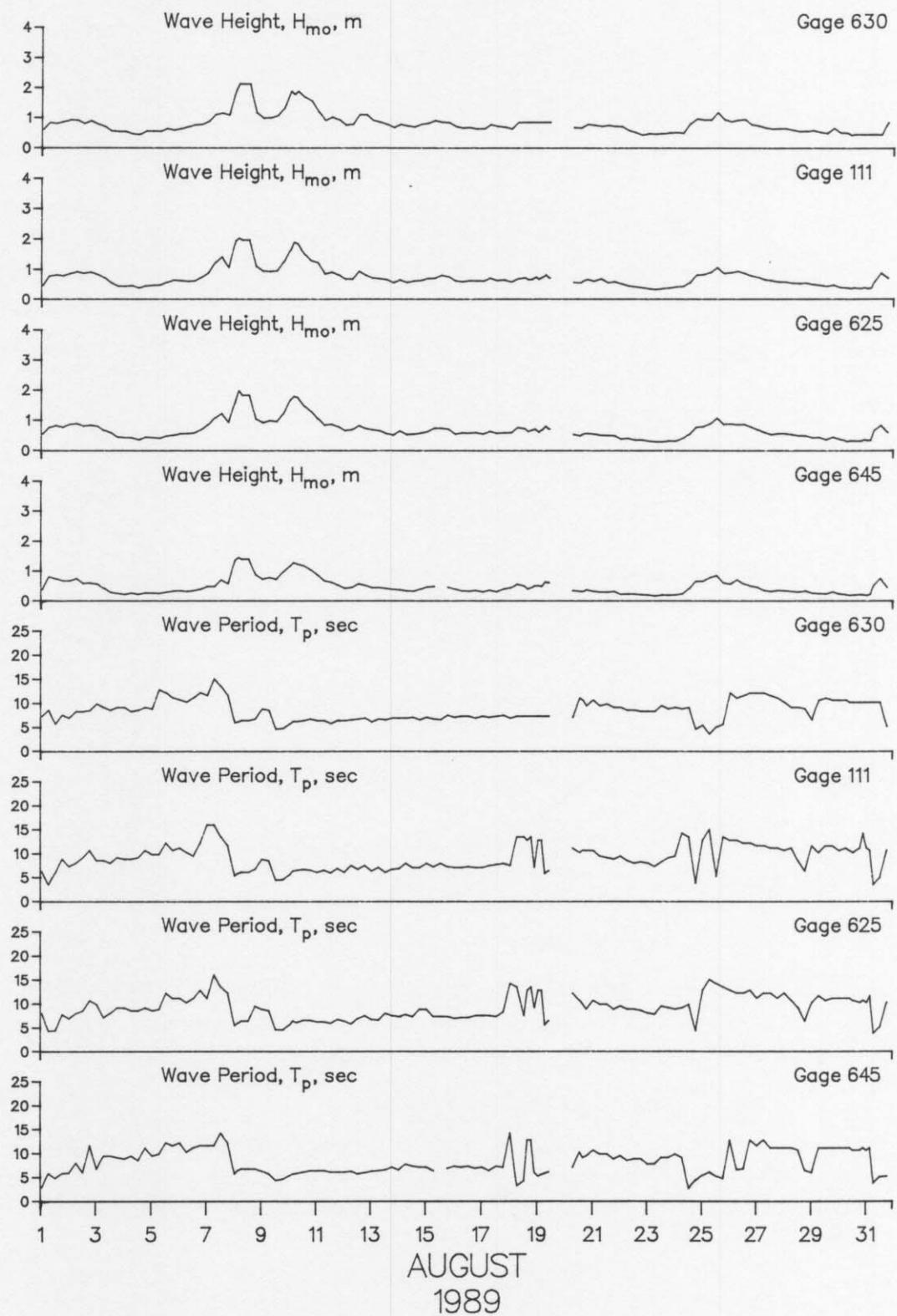
Table 3: Wave Data

Aug 1989

Day	Hour	645		625		111		630	
		Baylor at 7+80	Hmo,m T,sec	Baylor at 18+60	Hmo,m T,sec	Pressure Gage	Hmo,m T,sec	Offsho	Wvrdr
17	0100	0.30	7.11	0.54	7.53	0.60	7.11	0.62	7.31
	0700	0.36	6.40	0.63	7.53	0.70	7.53	0.76	7.11
	1300	0.30	7.31	0.56	7.31	0.62	7.76	0.70	7.31
	1900	0.40	7.11	0.57	8.26	0.63	8.00	0.68	7.53
18	0100	0.44	14.22	0.58	14.22	0.57	7.53	0.62	6.92
	0700	0.56	3.24	0.75	13.47	0.68	13.47	0.84	7.31
	1300	0.50	4.27	0.72	7.53	0.72	13.47	0.84	7.31
	1900	0.44	12.80	0.67	13.47	0.66	13.47	*	
19	0100	0.51	5.22	0.60	12.80	0.67	12.80	*	
	0700	0.63	5.82	0.79	5.57	0.81	5.82	*	
	1300								
	1900								
20	0100			Power Failure					
	0700	0.35	7.11	0.54	12.19	0.57	11.13	0.68	7.11
	1300	0.32	10.24	0.49	10.67	0.56	10.24	0.66	11.13
	1900	0.37	9.48	0.57	8.83	0.66	10.67	0.78	9.48
21	0100	0.32	10.67	0.55	10.67	0.61	10.67	0.75	10.67
	0700	0.29	9.85	0.51	9.85	0.68	9.48	0.71	9.48
	1300	0.29	9.85	0.50	9.85	0.56	9.14	0.74	9.85
	1900	0.31	8.83	0.49	8.83	0.58	8.83	0.71	9.14
22	0100	0.22	9.48	0.38	9.48	0.51	9.48	0.70	9.14
	0700	0.22	8.53	0.40	8.83	0.44	8.53	0.58	8.53
	1300	0.23	8.83	0.35	8.83	0.41	8.00	0.51	8.53
	1900	0.20	8.83	0.35	8.53	0.38	8.26	0.42	8.26
23	0100	0.19	7.76	0.31	8.00	0.34	8.00	0.47	8.26
	0700	0.16	7.76	0.29	7.76	0.32	7.31	0.45	8.26
	1300	0.20	9.14	0.29	9.48	0.35	8.26	0.47	9.48
	1900	0.19	9.14	0.32	9.14	0.38	9.14	0.50	8.83
24	0100	0.20	9.85	0.32	8.83	0.42	9.48	0.51	9.14
	0700	0.24	9.14	0.41	9.14	0.43	14.22	0.50	8.83
	1300	0.41	2.67	0.55	9.85	0.55	13.47	0.81	9.14
	1900	0.66	4.41	0.78	4.34	0.81	3.82	0.96	4.66
25	0100	0.67	5.45	0.79	12.80	0.83	12.80	0.93	5.45
	0700	0.78	6.09	0.89	15.06	0.90	15.06	0.94	3.66
	1300	0.86	5.22	1.07	14.22	1.05	5.22	1.18	5.12
	1900	0.60	4.74	0.87	13.47	0.86	13.47	0.94	5.69
26	0100	0.56	12.80	0.88	12.80	0.89	12.80	0.87	12.19
	0700	0.71	6.56	0.85	12.19	0.93	12.80	0.92	11.13
	1300	0.57	6.74	0.86	12.19	0.87	12.19	0.94	11.64
	1900	0.50	12.80	0.78	12.80	0.78	12.19	0.77	12.19
27	0100	0.45	11.64	0.68	11.13	0.73	11.64	0.73	12.19
	0700	0.35	12.80	0.60	12.19	0.65	11.64	0.66	12.19
	1300	0.31	11.13	0.53	12.19	0.62	11.13	0.62	11.64
	1900	0.35	11.13	0.55	11.13	0.57	11.13	0.63	11.13
28	0100	0.33	11.13	0.55	12.19	0.57	10.67	0.63	10.24
	0700	0.31	11.13	0.52	10.67	0.53	11.13	0.58	9.14
	1300	0.29	10.67	0.48	9.14	0.52	8.53	0.54	9.14
	1900	0.32	6.40	0.48	6.40	0.53	6.40	0.55	8.83
29	0100	0.25	5.95	0.41	10.24	0.48	11.64	0.58	6.56
	0700	0.23	11.13	0.42	11.64	0.46	10.24	0.51	10.67
	1300	0.22	11.13	0.36	10.67	0.42	11.64	0.48	11.13
	1900	0.30	11.13	0.44	11.13	0.47	11.64	0.65	10.67
30	0100	0.23	11.13	0.36	11.13	0.38	10.67	0.50	10.67
	0700	0.19	11.13	0.30	11.13	0.37	11.13	0.48	10.67
	1300	0.18	10.67	0.32	10.67	0.37	10.24	0.44	10.24
	1900	0.20	10.67	0.31	10.24	0.35	11.13	*	
31	0100	0.18	10.67	0.34	10.24	0.35	11.13	*	
	0700	0.52	3.77	0.67	3.77	0.58	3.46	*	
	1300	0.75	5.12	0.83	5.12	0.87	5.02	*	
	1900	0.46	5.22	0.61	10.24	0.70	10.67	0.85	5.22
Mean		0.47	8.09	0.68	9.05	0.72	9.04	0.80	8.43
Std dev		0.26	2.60	0.30	2.57	0.31	2.67	0.31	2.20

* Electronic problems

(Sheet 2 of 2)



PART IV: CURRENT DATA

Current data (Table 4) are collected from a Marsh-McBirney electromagnetic biaxial current meter (Table 1 and Figure 2) and by visually observing the movement of dye on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier 12 m offshore.

Since the shoreline orientation is approximately N20W, longshore currents flow either toward 340 deg (i.e. northward) or toward 160 deg (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward).

All current speeds are given in centimeters per second (cm/sec). Resultant speeds and directions are determined by vector averaging the data.

Table 4: Current Data
Aug 1989

Alongshore Cross-shore Resultant Time Day	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter		
	Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
1 0100-Along Cross Result											
1 0700-Along Cross Result	68 17 70	S on 174		165	32 2 32	S on 163		58	S		
1 1300-Along Cross Result											
1 1900-Along Cross Result											
2 0100-Along Cross Result											
2 0700-Along Cross Result	38 13 40	S on 179		165	32 10 33	S on 177		82	S		
2 1300-Along Cross Result											
2 1900-Along Cross Result											
3 0100-Along Cross Result											
3 0700-Along Cross Result	36 13 38	S off 141		165	9 7 11	S off 121		8	S		
3 1300-Along Cross Result											
3 1900-Along Cross Result											
4 0100-Along Cross Result											
4 0700-Along Cross Result	21 11 24	N off 7		152	14 5 15	N off 2		0			
4 1300-Along Cross Result											
4 1900-Along Cross Result											
5 0100-Along Cross Result											
5 0700-Along Cross Result	17 17 25	S off 115		165	14 4 15	S off 143		0			
5 1300-Along Cross Result											
5 1900-Along Cross Result											

KEY = All speeds in cm/sec

N = Northward, Shore parallel

S = Southward, Shore parallel

on = onshore off = offshore

Table 4: Current Data (Continued)
Aug 1989

Day	Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter	
		Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed
6 0100	Along Cross Result										
6 0700	Along Cross Result	10 1 10	N on 334		177	21 2 21	N on 334		58	N	
6 1300	Along Cross Result										
6 1900	Along Cross Result										
7 0100	Along Cross Result										
7 0700	Along Cross Result	18 13 22	N on 305		226	32 2 32	N off 343		109	N	
7 1300	Along Cross Result										
7 1900	Along Cross Result										
8 0100	Along Cross Result										
8 0700	Along Cross Result	55 25 61	S on 184		226	68 20 71	S on 177		130	S	
8 1300	Along Cross Result										
8 1900	Along Cross Result										
9 0100	Along Cross Result										
9 0700	Along Cross Result	0 2 2		on 250	189	8 3 8	N on 318		24	N	
9 1300	Along Cross Result										
9 1900	Along Cross Result										
10 0100	Along Cross Result										
10 0700	Along Cross Result	0 3 3		on 250	372	21 8 23	S off 138		46	S	
10 1300	Along Cross Result										
10 1900	Along Cross Result										

KEY = All speeds in cm/sec
 N = Northward, Shore parallel
 S = Southward, Shore parallel
 on = onshore off = offshore

Table 4: Current Data (Continued)
Aug 1989

Alongshore Cross-shore Resultant ---- Time Day	Pier Measurements						Beach Measurements (500m Updrift)			Current Meter	
	Dye at (579 m) (surface)		Distance from Baseline (m)		Dye 12m offshore (surface)		Location	Speed	Dir	Speed	Dir
11 0100-Along Cross Result											
11 0700-Along Cross Result	16 8 18	S on 187	177	12 5 13	N on 316		South	37	N		
11 1300-Along Cross Result											
11 1900-Along Cross Result											
12 0100-Along Cross Result											
12 0700-Along Cross Result	55 3	N on 337	189	68 7 68	N on 334		South	46	N		
12 1300-Along Cross Result											
12 1900-Along Cross Result											
13 0100-Along Cross Result											
13 0700-Along Cross Result	13 0 13	N on 340	189	87 22 90	N on 326		South	43	N		
13 1300-Along Cross Result											
13 1900-Along Cross Result											
14 0100-Along Cross Result											
14 0700-Along Cross Result	6 9 11	S on 216	189	4 2 5	N on 311		South	46	N		
14 1300-Along Cross Result											
14 1900-Along Cross Result											
15 0100-Along Cross Result											
15 0700-Along Cross Result	29 4 29	S on 169	165	76 15 78	N on 329		South	40	N		
15 1300-Along Cross Result											
15 1900-Along Cross Result											

KEY = All speeds in cm/sec
 N = Northward, Shore parallel
 S = Southward, Shore parallel
 on = onshore off = offshore

Table 4: Current Data (Continued)
Aug 1989

Alongshore Cross-shore Resultant Time Day	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter		
	Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
16 0100-Along Cross Result									46 N		
16 0700-Along Cross Result	55 0	S		177	17	2	S off	12m offshore	North		
16 1300-Along Cross Result	55	160				17	154				
16 1900-Along Cross Result											
17 0100-Along Cross Result											
17 0700-Along Cross Result	47 2	S on		177	21	6	S on	52 N			
17 1300-Along Cross Result	47	163			22	177		North			
17 1900-Along Cross Result											
18 0100-Along Cross Result											
18 0700-Along Cross Result	10 6	N on		165	15	4	N on	17 S			
18 1300-Along Cross Result	12	307			15	323		South			
18 1900-Along Cross Result											
19 0100-Along Cross Result											
19 0700-Along Cross Result	17 10	S off		152	55	6	N on	17 N			
19 1300-Along Cross Result	20	129			56	334		South			
19 1900-Along Cross Result											
20 0100-Along Cross Result											
20 0700-Along Cross Result	30 12	N off		165	20	6	N on	14 N			
20 1300-Along Cross Result	33	2			21	323		South			
20 1900-Along Cross Result											

KEY = All speeds in cm/sec
 N = Northward, Shore parallel
 S = Southward, Shore parallel
 on = onshore off = offshore

Table 4: Current Data (Continued)
Aug 1989

Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter	
	Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface) Distance from Baseline (m)		Dye 12m offshore (surface)		Location		Speed	Dir
Day	Speed	Dir	Speed	Dir	Speed	Dir	Speed	Dir	Speed	Dir
21 0100-Along Cross Result										
21 0700-Along Cross Result	32 5	N off	177		20 8	N off	9	N		
21 1300-Along Cross Result	32 349				22	2	South			
21 1900-Along Cross Result										
22 0100-Along Cross Result										
22 0700-Along Cross Result	7 3	N off	165		25 6	N off	9	N		
22 1300-Along Cross Result	8 2				26	354	South			
22 1900-Along Cross Result										
23 0100-Along Cross Result										
23 0700-Along Cross Result	0 12		165		7 15	N off	8	N		
23 1300-Along Cross Result	12 70				17	43	South			
23 1900-Along Cross Result										
24 0100-Along Cross Result										
24 0700-Along Cross Result	61 0	S	177		11 2	S off	17	S		
24 1300-Along Cross Result	61 160				11	151	North			
24 1900-Along Cross Result										
25 0100-Along Cross Result										
25 0700-Along Cross Result	18 5	S on	152		47 28	S off	14	N		
25 1300-Along Cross Result	19 174				55	129	South			
25 1900-Along Cross Result										

KEY = All speeds in cm/sec
N = Northward, Shore parallel
S = Southward, Shore parallel
on = onshore off = offshore

Table 4: Current Data (Continued)
Aug 1989

Day	Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter	
		Dye at (579 m) (surface)	Speed	Dir	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed
26	0100-Along Cross Result									
26	0700-Along Cross Result	17 17 25	S off 115		177	13 4 13	S on 179		6 S	
26	1300-Along Cross Result									
26	1900-Along Cross Result									
27	0100-Along Cross Result									
27	0700-Along Cross Result	20 5 21	N off 354		165	36 9 37	N off 354		21 N	
27	1300-Along Cross Result									
27	1900-Along Cross Result									
28	0100-Along Cross Result									
28	0700-Along Cross Result	16 3 17	N off 351		165	16 2 16	N off 349		no observation	
28	1300-Along Cross Result									
28	1900-Along Cross Result									
29	0100-Along Cross Result									
29	0700-Along Cross Result	18 18 25	N off 25		152	14 3 14	N off 354		27 N	
29	1300-Along Cross Result									
29	1900-Along Cross Result									
30	0100-Along Cross Result									
30	0700-Along Cross Result	23 23 32	N off 25		152	23 8 24	N off 359		7 N	
30	1300-Along Cross Result									
30	1900-Along Cross Result									

KEY = All speeds in cm/sec
 N = Northward, Shore parallel
 S = Southward, Shore parallel
 on = onshore off = offshore

Table 4: Current Data (Concluded)
Aug 1989

Day	Time	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter	
		Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed
31	0100-Along Cross Result										
31	0700-Along Cross Result	15 4 16	S off 143		152		32 3 32	S off 154		North	35 S
31	1300-Along Cross Result										
31	1900-Along Cross Result										

KEY = All speeds in cm/sec
 N = Northward, Shore parallel
 S = Southward, Shore parallel
 on = onshore off = offshore

PART V: SUPPLEMENTAL OBSERVATIONS

Visual wave direction measurements (Table 5) of both the primary wave train (i.e. that having the larger wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves but not surface chop or capillary waves) are taken daily at the seaward end of the pier. The direction of the primary wave train just north of the seaward end of the pier is also determined using a Raytheon Marine Pathfinder radar and measuring the alignment of the wave crests at approximately the same location as the visual measurements. The pier axis (considered perpendicular to the beach at the FRF) is orientated 70 deg east of true north; consequently, wave angles greater than 70 deg indicate that the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and visibility are also taken daily at the seaward end of the pier. A jar along with a thermometer is lowered about 0.3 m into the water and allowed to remain for at least one minute. The jar is removed, the temperature read, and a hydrometer is used to determine the density. A Secchi disc is used to determine the surface visibility.

Table 5: Supplemental Observations

Aug 1989

Day	Time	Wave Approach		Radar Wave Angle deg from True N	Width of Surf Zone,m	Water Characteristics at Pier End		
		Primary	Secondary			Temp.,C	Density g/cc	Secchi Vis.,m
1	0804	10			20	26.1	1.0194	2.7
2	0740	10			24	26.1	1.0177	3.7
3	0750	25			21	25.6	1.0172	3.4
4	0745	120	5		10	26.4	1.0168	4.9
5	0930	115			9	25.6	1.0192	2.4
6	0955	120			27	27.2	1.0182	5.8
7	0712	105			171	26.6	1.0186	5.2
8	0714	35		55	314	26.1	1.0186	2.7
9	0800	30		35	31	25.6	1.0173	1.5
10	0840	100	35		228	25.0	1.0155	1.8
11	0755	120	10		23	24.5	1.0162	0.6
12	0910	150			29	24.5	1.0194	2.4
13	0817	100			21	25.0	1.0180	4.3
14	0800	115		inoperative	21	26.1	1.0170	4.0
15	0734	100		90	43	26.5	1.0146	3.0
16	0900	95			21	26.6	1.0130	1.8
17	0735	100			30	26.6	1.0132	2.1
18	0712	85		80	27	26.8	1.0156	2.4
19	0632	110			30	26.4	1.0146	1.5
20	0635	60	100		12	26.1	1.0186	0.9
21	0625	110			34	25.6	1.0216	0.9
22	0745	none visible			18	22.2	1.0226	0.9
23	0650	none visible			3	22.7	1.0224	1.5
24	0725	85	40	70	15	26.7	1.0202	2.4
25	0650	50		65	30	26.6	1.0172	1.5
26	0702	65		70	43	26.4	1.0174	1.2
27	0804	80			15	25.8	1.0172	2.1
28	0611	95		80	15	26.4	1.0196	3.4
29	0635	80			12	26.1	1.0200	2.7
30	0652	none visible			6	21.1	1.0224	1.5
31	0710	25			12	25.0	1.0232	2.7

PART VI: WATER LEVELS

Since 1978, the National Oceanic and Atmospheric Administration (NOAA)/National Ocean Service (NOS) has operated a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A Leupold-Stevens digital recording float-type tide gage is used to collect instantaneous water level data every 6 minutes throughout the month.

The variation in water level during the month is shown in Figure 4 along with a list of mean and extreme values. This presentation is useful in identifying effects of both meteorological and astronomical forces on the open coast water level.

Table 6 contains the time at the center of each 12.42-hr tidal cycle and the range, high, low, and mean water levels during each tidal cycle.

FRF Tide Heights

Aug 1989

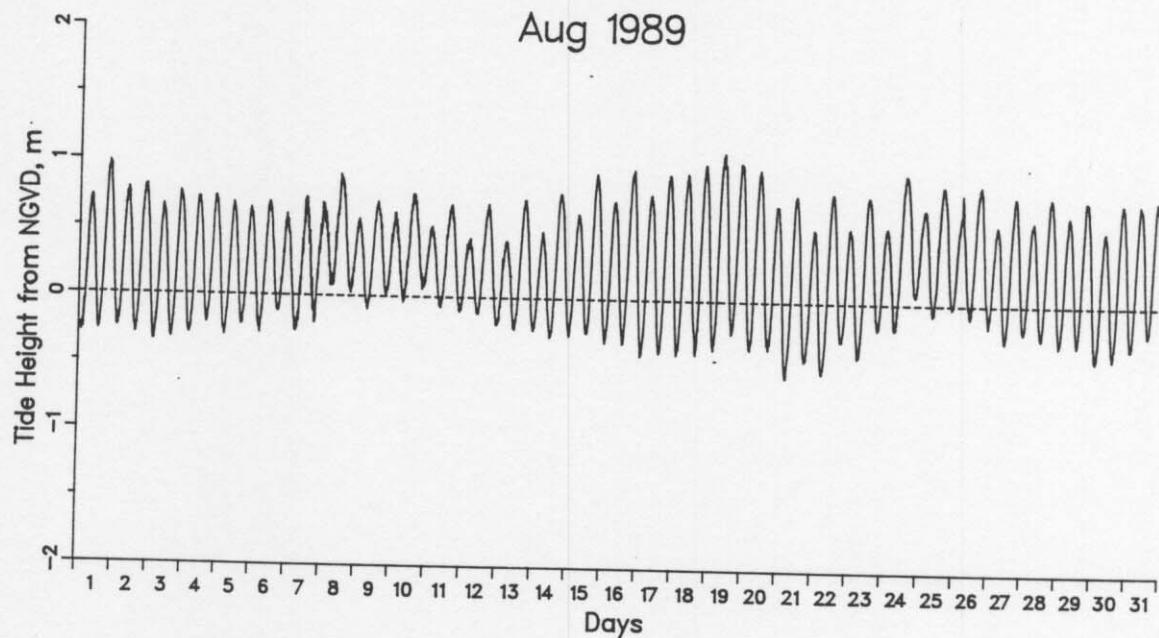


Figure 4. Water Level Time History

Monthly Water Levels, m NGVD

Extreme Low	=	-0.56	on day 21	at 354 EST
Extreme High	=	1.10	on day 19	at 854 EST
Monthly Mean	=	0.26		
Mean Low	=	-0.27		
Mean High	=	0.75		
Mean Range	=	1.01		

Table 6: Water Levels, m NGVD

		Aug 1989			
Mid-Cycle Day	Time	Low	High	Mean	Range
1	612	-0.29	0.73	0.20	1.01
1	1837	-0.27	0.98	0.36	1.25
2	703	-0.26	0.79	0.24	1.05
2	1928	-0.31	0.81	0.27	1.12
3	753	-0.34	0.66	0.15	1.01
3	2018	-0.32	0.76	0.23	1.09
4	843	-0.29	0.72	0.23	1.01
4	2109	-0.27	0.73	0.24	1.00
5	934	-0.30	0.69	0.20	0.98
5	2159	-0.28	0.65	0.19	0.93
6	1024	-0.24	0.69	0.25	0.94
6	2249	-0.26	0.61	0.18	0.87
7	1115	-0.24	0.73	0.24	0.97
7	2340	-0.20	0.69	0.32	0.89
8	1205	0.04	0.91	0.48	0.86
9	30	-0.10	0.57	0.25	0.67
9	1255	-0.05	0.70	0.35	0.75
10	121	-0.04	0.62	0.28	0.66
10	1346	0.00	0.77	0.42	0.77
11	211	-0.08	0.52	0.24	0.60
11	1436	-0.11	0.69	0.32	0.79
12	301	-0.12	0.44	0.16	0.56
12	1527	-0.20	0.69	0.28	0.89
13	352	-0.23	0.42	0.09	0.65
13	1617	-0.23	0.73	0.26	0.96
14	442	-0.29	0.49	0.09	0.78
14	1707	-0.27	0.78	0.28	1.05
15	532	-0.28	0.63	0.17	0.91
15	1758	-0.30	0.94	0.34	1.23
16	623	-0.33	0.73	0.21	1.05
16	1848	-0.42	0.97	0.32	1.39
17	713	-0.40	0.78	0.19	1.19
17	1938	-0.40	0.94	0.28	1.34
18	804	-0.38	0.95	0.29	1.33
18	2029	-0.40	1.02	0.34	1.41
19	854	-0.32	1.10	0.43	1.43
19	2119	-0.36	1.03	0.36	1.39
20	944	-0.34	0.98	0.32	1.33
20	2210	-0.56	0.71	0.12	1.27
21	1035	-0.54	0.79	0.17	1.33
21	2300	-0.52	0.54	0.00	1.07
22	1125	-0.49	0.81	0.22	1.30
22	2350	-0.41	0.55	0.08	0.96
23	1216	-0.39	0.79	0.28	1.19
24	41	-0.20	0.56	0.18	0.76
24	1306	-0.19	0.96	0.50	1.15
25	131	-0.07	0.70	0.35	0.77
25	1356	-0.08	0.88	0.44	0.96
26	222	-0.04	0.82	0.31	0.86
26	1447	-0.10	0.89	0.42	0.98
27	312	-0.24	0.59	0.19	0.83
27	1537	-0.27	0.80	0.29	1.08
28	402	-0.20	0.62	0.20	0.83
28	1628	-0.25	0.80	0.29	1.05
29	453	-0.30	0.67	0.18	0.97
29	1718	-0.30	0.78	0.24	1.09
30	543	-0.41	0.56	0.07	0.97
30	1808	-0.40	0.77	0.21	1.16
31	634	-0.32	0.76	0.24	1.08
31	1859	-0.22	0.79	0.31	1.01

PART VII: NEARSHORE PROFILES

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using the CRAB-Zeiss surveying system; a Zeiss Elta-2 first-order, self-recording electronic theodolite distance meter in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 5 shows the last survey in July and the two surveys in August on profile line 188, located 517 m south of the pier. The removal of the berm (80 - 100 m) is the only significant change to the profile.

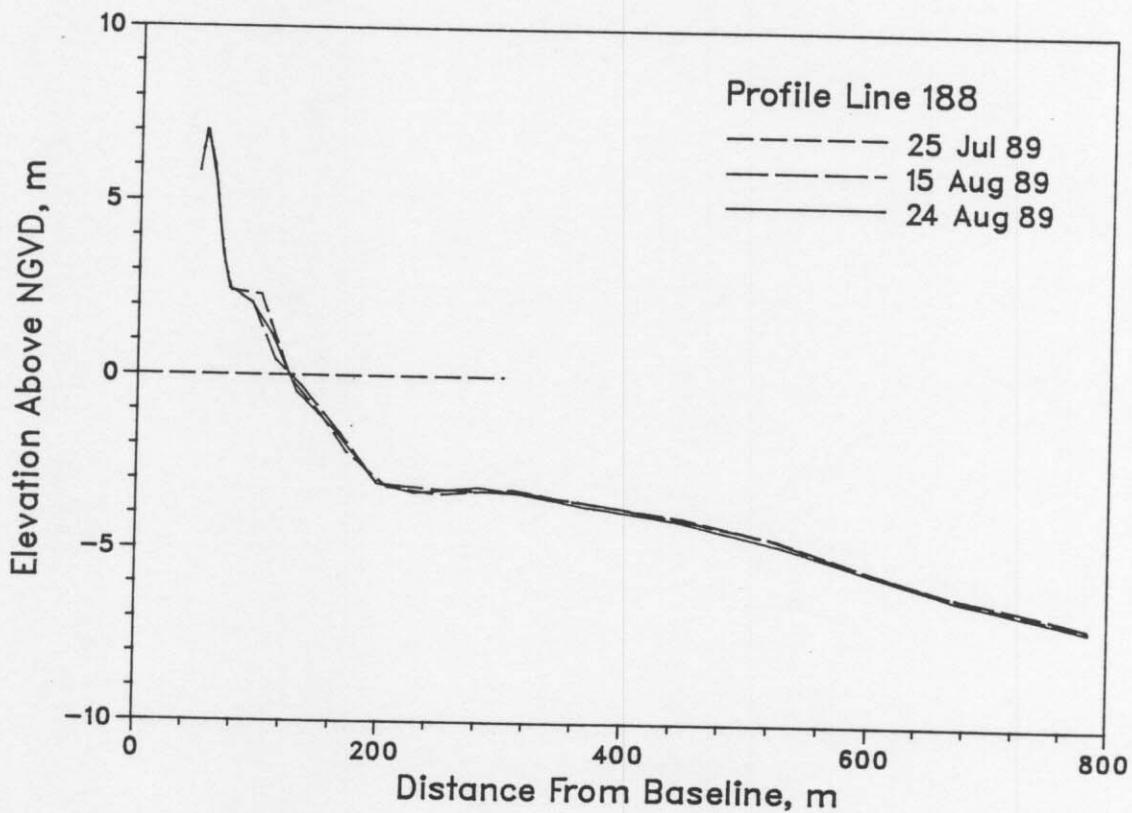


Figure 5. Monthly CRAB profiles on profile 188 -
517 m south of pier.

The profile envelope (Figure 6) reflects the maximum changes that occurred on the profile during 1988. There were no changes to the envelope during August.

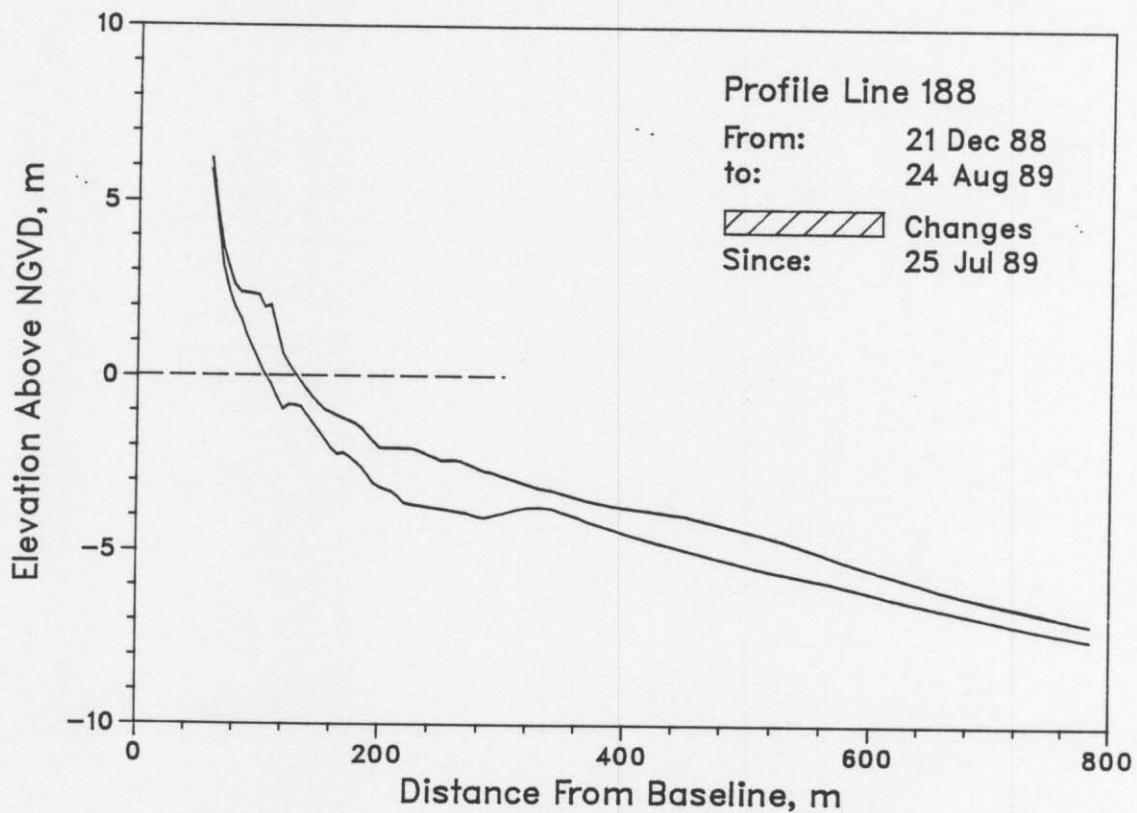


Figure 6. CRAB profile envelope - profile 188.

B. Bathymetry. Figure 7 includes a two- and three-dimensional contour map and a change plot derived from the bathymetric survey on 15 August. Wide contour lines on the change diagram represent eroded areas; thin lines indicate deposition.

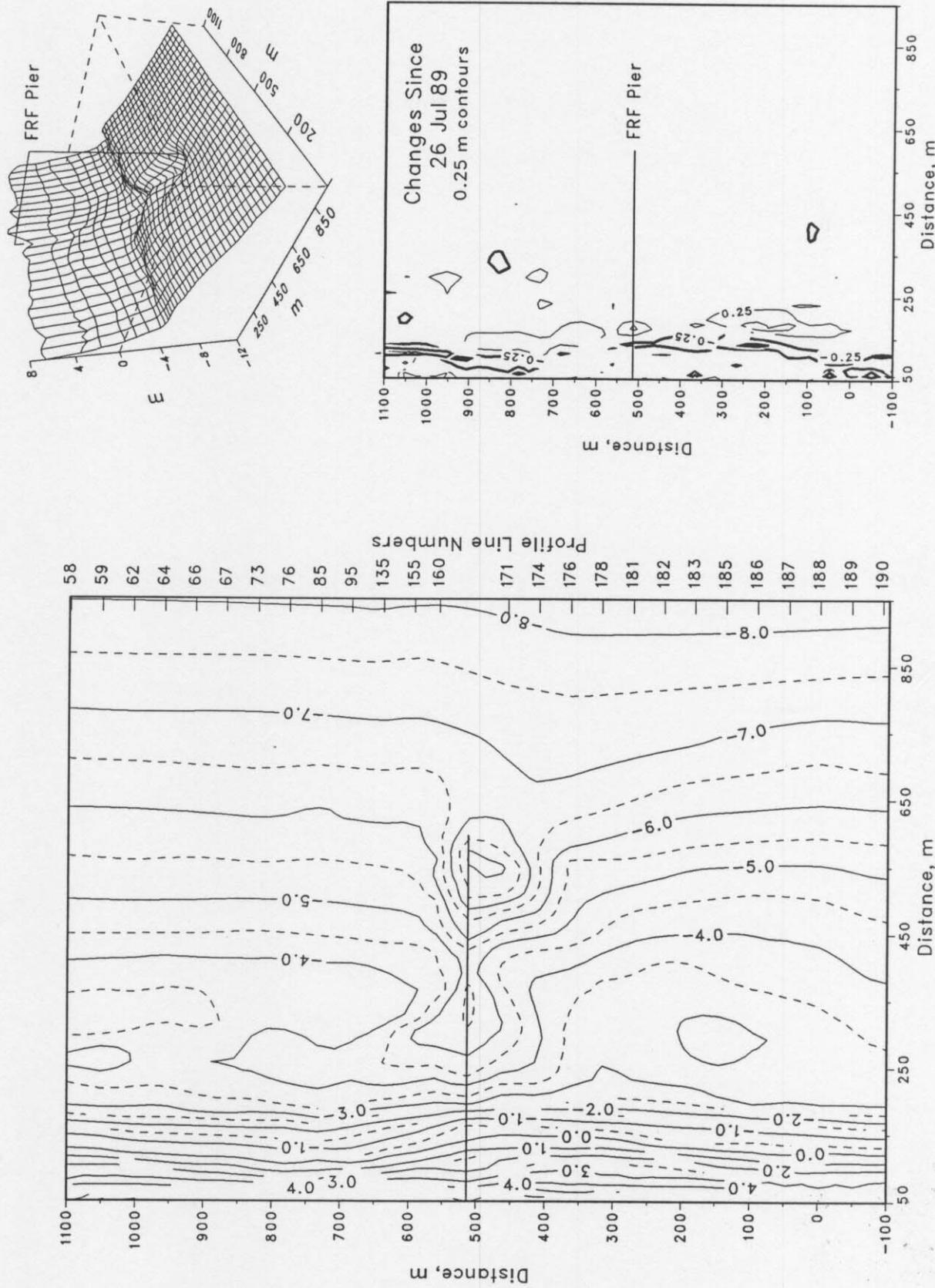


Figure 7. FRF bathymetry 15 Aug 89 depths relative to NGVD

Distribution List

Government Agencies:

OCE	U.S. Geological Survey
BERH	U.S. National Park Service
NAO	U.S. Naval Academy
NASA/Wallops Flight Center	U.S. Naval Civil Eng. Lab
NOAA (NOS, NWS)	U.S. Naval Fac. Eng. Com.
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Prince George's College	University of Rhode Island
Rutgers University	University of Virginia
Scripps Inst. of Oceanography	Va. Inst. of Marine Science
Southern Illinois University	

Others:

City of Va. Beach, VA	MEC Systems Corporation
Coastal Barge Corporation	Moffatt & Nichol, Eng.
Coastal and Est. Res., Inc.	Offshore Coastal Technologies
Coastal Science & Eng., Inc.	Mr. Rowland
Dr. Galvin	Mr. Savage
GEOMET Tech., Inc.	Sea Port Supply Corp.
Greenhorne & O'Mara, Inc.	Shell Development
Dr. Hylton	Sherwood Industries
Mary Marr, Inc.	Mr. & Mrs. Valpey
Mr. Mason	WCTI-TV
Masonite Corporation	SEASUN Power Systems

Foreign:

W. F. Baird & Asso. Coastal Engineers, Ltd (Canada)
Queen's University, Ontario (Canada)
Ministry of Construction, Coastal Division (Japan)
Norwegian Hydrodynamic Laboratories (Norway)
University of New South Wales (Australia)
University of Sydney (Australia)